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Design and Analysis of Wall Mounted Jib Crane

[1]Naveen.A.Hanchate, [2]Akhil.A.Deshpande
[1,]Student, KLS Gogte Institute of Technology,Belagavi.
[2.] Asst.Proffesor, KLS Gogte Institute of Technology,Belagavi.

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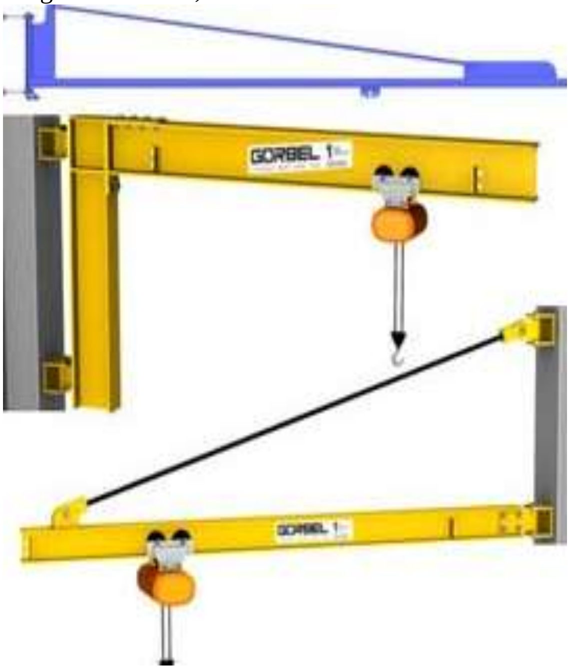
ABSTRACT: A jib crane is a type of crane with a cantilevered beam, hoist, and trolley that cantilevers vertically from an independent floor mounted column or is attached to a building column. This paper will mainly concentrate wall mounted jib cranes here the trolley hoist moves along the length of the boom and the boom spin allowing the lifted load to be skillfully about in a relatively circular area. Several aspects must be considered while building a jib crane, the most important of which are the crane's own weight and the weight of the items.
The goal of this thesis is to construct and analyze a jib crane in detail. This project investigates the deformation in the jib crane with different materials and the work is carried out by designing reinforcement to overcome those deformation in the component. Models are created in modelling software using the analytical design dimensions, and analysis is performed on the models using a finite element solver under appropriate conditions, with the results compared.
KEYWORDS:JIB CRANE, UG-NX, ANSYS.

I. INTRODUCTION

The Jib crane machines having total three degrees of freedom, namely rotator motions, radial motions and vertical motions. Anyhow they cannot reach to corner places, this one of the drawback of crane. They were probably used when activity is positioned or localized. The capacity of lifting the loads usually varies from 0.5 tons to 250 or 300 tons depending upon the design and type of cranes. Generally the crane machines are widely used in project site, construction area, outdoor works etc.



Lifting height may be 25 meters or more than that, depending on structure of the crane. Jib crane machines are used more in ship yards for lifting the heavier machine equipments, which may be weighing from 100 tons to 300 tons. These cranes are provided with two main hosting winches which can be employed singly or together to lift the loads. Free standing jib cranes are more beneficial

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where high amount of productivity is required. These crane machines are basically works from general motorized system. The standard span dimensions of free standing jib crane are 8'-10'. The crane was invented by Mr. Gibb in the year of 1934; plans were drawn for its reconstructions. Actually the first jib crane machine was used by David round company in the year of 1869, handling is very simple for operators while lifting the loads. And also the cranes are simple in design, the working of crane is very friendly, it consist of solid boom shackled to pivoted point, in turn this pivot is mount on top of the freely standing column. And it allows up to 180 -360 degree rotations depending upon the type of crane machine. Lifting is carried out by pulling by chain hoist or motorized chain system, free standing jib crane offers 360 degree rotation and wall bracket is offered with 200 degree rotations.

There are so many types of jib cranes are used now a days, each having with different operation skills and with different features depends upon the type of work to be carried out, for ex; when Huge load has to be lifted out, then free standing crane will be used, where wall bracket is used for simple type of load lifting.

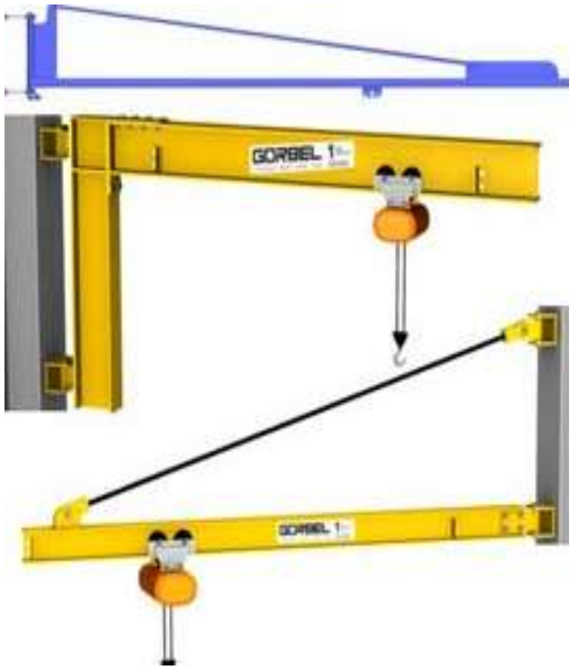
1.2. FREE STANDING JIB CRANE

Floor mounted jib crane is directly fixed on the floor without any kind of support, to keep it upside. To maintaining its stability and not to overlap, which is fix into the foundation of 3m to 5m deep and 4 to 12 feet square foundation from the base. The foundation is depending on load and its reach. The main advantage of this jib crane machine is it does not require any wall support. It is also provide optimal range of span and gives good control to operate.

1.1.TYPES OF JIB CRANE

1.3. WALL MOUNTED JIB CRANE

Wall mounted jib crane like its name only suggest that it is fitted into the wall. It is required less head space to mount the crane. So it can be comfortably fitted under the roof. And it provide the maximum lifted weight from the hoist, this crane machine is more effective when the material is lift and moved when less space is available, it works when area of the floor is not available. It isn't big in size and more effective when productivity is required. It offers 200 degree rotations.



1.4.WALL BRACKET JIB CRANE

This wall bracket jib crane is most similar to wall mounted jib crane machine except bracket. It is most economical means of providing hoist coverage for different different use in bays. Along wall or column of plant. The rotation and installation, applying loads are similar to wall mounted crane. It offers 360 degree rotations.

1.5. MASTER STYLE JIB CRANE

This master style jib crane is similar to free standing jib crane machine and it does not required any special kind of basement to making it more economical. but it do required mounting at the top and bottom. It is also offer 360 degree of rotation depending upon the manufacturer and maximum amount of lift with full use of headroom.

II. LITERATURE REVIEW

Mr.FaudHadzikadunic, Mr. Omer Jukic, Mr.FaudHadzikadunic, Mr.FaudHadzikadunic, Mr.Faud Had A broader assessing methodology for construction and static-dynamic behavior of a certain crane type – offered here is a jib crane – is presented in this research. This methodology is applicable to other types of cranes; however, applying computation numerical methods and CAD technology to these complex constructions is critical, as it allows for the most up-to-date access to actual design and constructive diagnostics. An effective methodology for calculating and designing a genuine model of jib crane construction is provided in this research, with the ultimate goal of local and global structure optimization using CAD technology. The outcomes of dynamic static analyses of complicated configuration behavior can be extremely useful. the significance of significant progress This research resulted in a new structural idea for a jib crane with improved static and dynamic parameters in the same area. Several objectives are fulfilled by changing the geometry of the structure.

I. Gerdemeli, S. Kurt K., and B. Tasdemir JIB cranes have been studied, which are commonly utilised in ship repair and manufacturing procedures. The findings of the analytical computation were compared to the results produced using the finite element approach. The reliability of the finite element method for JIB crane design has been investigated in this way. As a result, it has been determined that F.E.M is the most trustworthy and practical method for use in the design of JIB cranes.

Finally, the findings of the analytical computation were compared to the results produced using the finite element approach. And it was discovered that the error margins were produced between the permissible boundaries, based on these comparison results.

Subhash N. Khetre, S. P. Chaphalkar, ArunMeshram In this paper, the method of final designing of column Bracket and boom for Material handling jib crane system. For some characteristics of jib cranes, such as yield deflection of column, the basic functions are determined. Stress and displacement studies were used to determine the bracket, strength, and boom. It necessitates the transportation of large, difficult-to-move loads. Solid Works and COSMOS are employed in the column Bracket and Boom analysis, which is carried out in two load phases.. Jib crane is design, analyze and develop from three most prevalent materials.

AjinkyaKarpe, SainathKarpe, AjaykumarChawrai In this paper, author has selected jib for analysis since we wanted to validate the use of ANSYS (FEM method) for structural design of Tower Crane Jib. The jib model was created in ANSYS 14.5 workbench and examined there as well. The axial force and deformation created in members of the Tower Crane jib were compared first, and the superior model was chosen for further investigation. The load was applied at the end of the tower crane's jib throughout the analysis to generate the maximum moment and stresses in the jib. Initially, the ANSYS 14.5 results for the jib were validated using an analytical method. Because the components' permitted stress of Material (Structural Steel) is more than the jib's computed stress values. According to I.S regulations, the permissible stress of Material (Structural Steel) of the components is observed, and the jib crane is safe. The findings of the analytical and FEA

(ANSYS) models are fairly similar. The outcomes demonstrate that the boundary conditions were set correctly.

Amit.S.Chaudhary, Subin.N.Khan The study includes an investigation of the stresses, deflections of regular I Section Cantilever Beam of jib crane subjected to UDL(self weight) and concentrated load at free end. Different shapes of cantilever are proposed in this study with different materials. To compute and validate results, FEA and experimental studies are carried out for the regular and proposed beams.

III. PROBLEM DEFINITION

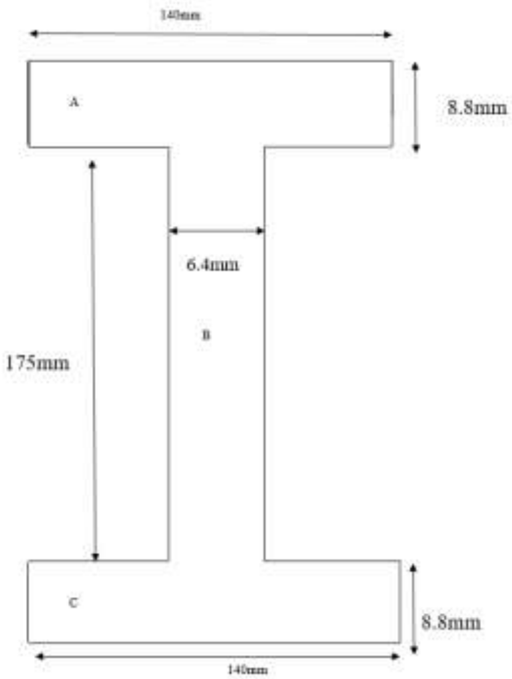
When the load acts at the crane's maximum span, the load on the boom of a jib crane reaches its maximum load. The boom of the jib crane, which is composed of I-section beam, bends in this situation. This could eventually lead to the jib crane's serious failure. This study studies the stress regions in the jib crane using various materials, and the task is completed by designing reinforcement to alleviate the component's stresses. Models are created in modelling software using the analytical design dimensions, and analysis is performed on the models using a finite element solver under appropriate conditions, with the results compared.

3.1.OBJECTIVES OF THE PROJECT

- The project's main goal is to offer an optimal boom structure for a specific jib crane.
- Another objective is to design and analysis optimized boom of jib crane to increase its Strength.

IV. DESIGN AND CALCULATIONS

4.1. DIMENSIONS OF I SECTION



4.2.Material properties

1. Structural steel

- Density: 7.85 X 10-6 Kg/mm
- Young's modulus: 2 x 105 Mpa
- Passions ratio: 0.3

2. ASME A36 Steel

- Density: 7.80 X 10-6 Kg/mm
- Young's modulus: 2 x1011 Mpa
- Passions ratio: 0.32

4.3.STRUCTURAL STEEL

1. SELF WEIGHT = $\rho * v$

$= 7.85*10^{-6}x3584x6000$

= 168.8064 kg

Total force P = 1655.99 N

2. MOMENT OF INERTIA FOR I BEAM

$I_x = (I_x + A.dy^2) A + (I_x + A d^2 y) B + (I_x + A.d y^2) C$

$I_x = ((140X8.8^3)/12 + (140*8.8) * 4.4^2) + ((6.4*175^3)/12 + (6.4 X 175 X 96.3^2 + ((140*8.8^3)/12 + 140X8.8 X188.2^2)$

Ix =56.901*10^6 mm^4

3.DEFLECTION

δ max=PL^3/3EI

δmax=(1655.99X6000^3)/(3X200X⟦10⟧^3 X56.901X10^6)

δ max=10.47 mm

4.4.ASME A36 STEEL
1. SELF WEIGHT = ρ*v
=7.80*10^-6x3584x6000
= 167.73 kg
Total force P = 1645.43 N

2. MOMENT OF INERTIA FOR I BEAM
Ix = (Ix+ A.dy^2) A + (Ix + A d^2 y) B + (Ix + A.d y^2) C
Ix =((140X8.8^3)/12 + (140*8.8) * 4.4^2) + ((6.4*175^3)/12 + (6.4 X 175 X 96.3^2 + ((140*8.8^3)/12 + 140X8.8 X188.2^2)

Ix =56.901*10^6 mm^4

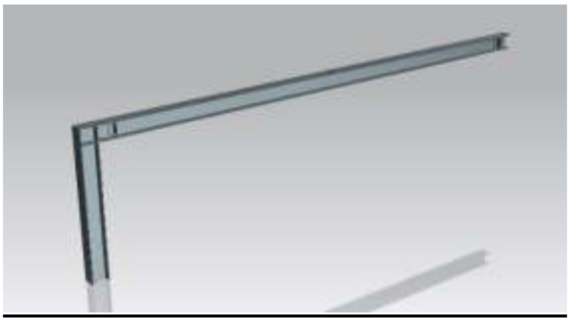
3. DEFLECTION
δ max=PL^3/3EI

δmax=(1645.43X6000^3)/(3X200X⟦10⟧^9 X56.901X10^6)

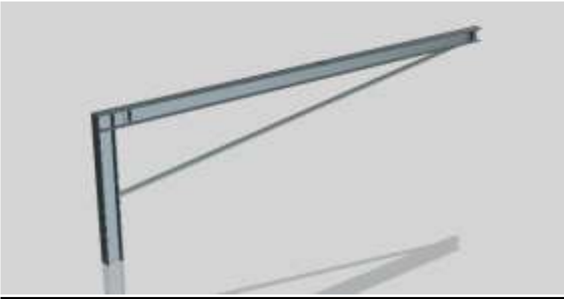
δmax=1.04*10^(-5) mm

V.MODELLING

5.1.3D MODELS
5.1.1.JIB CRANE



5.1.2.REINFORCED JIB CRANE



5.2. CONSTRAINTS
In this work, the following design limitations were applied.

- First constraint is the selection of jib crane. Different jib crane have different jib crane configuration & sizes, height, column, span length, boom size etc. Methodology presented in this study can be extended to any jib crane, if the jib crane dimensions are known. Data for crane dimensions has been employed.
- Second constraint is that today's industry demands versatile, efficient equipment while at the same time providing more flexibility along with significant savings through increased productivity. A jib crane can aid in the efficient handling of items and the flow of work.

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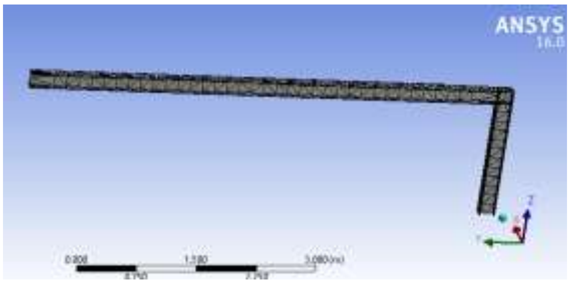
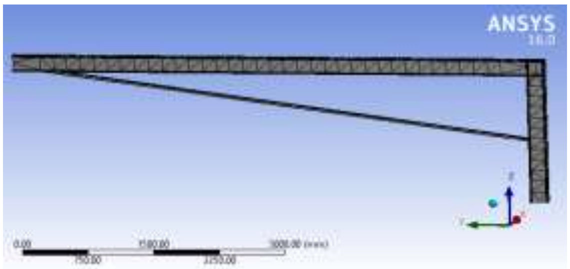
VI.ANALYSIS

6.1.MESHED PARTS

6.1.1.JIB CRANE



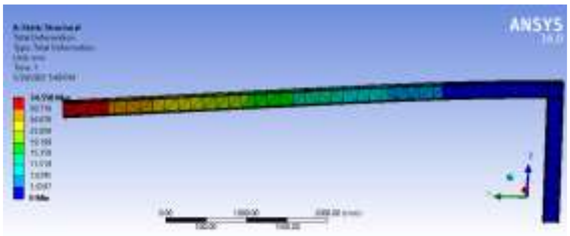
6.1.2.REINFORCED JIB CRANE



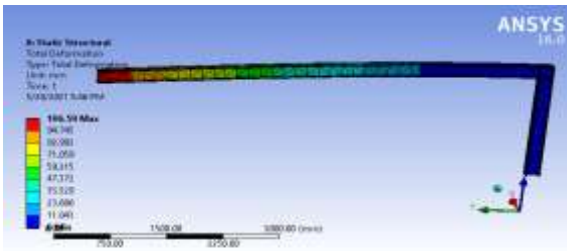
6.2.ANALYSIS OF JIB CRANE

6.2.1.STRUCTURAL STEEL

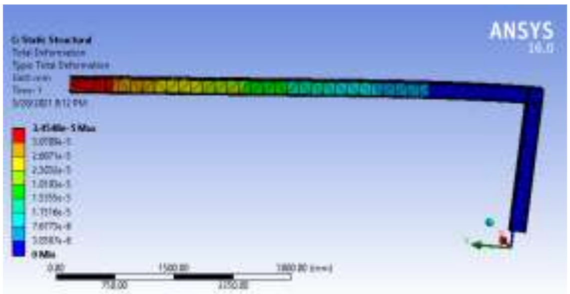
A. MIDDLE OF THE SPAN



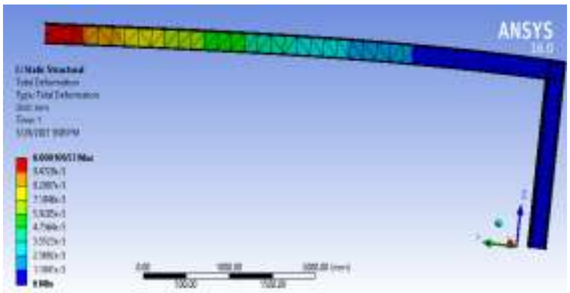
B. END OF THE SPAN



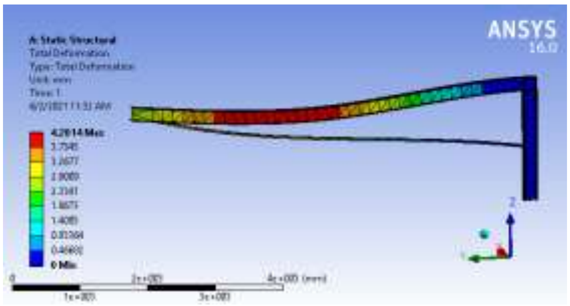
6.2.2.ASME A36 STEEL
A.MIDDLE OF THE SPAN



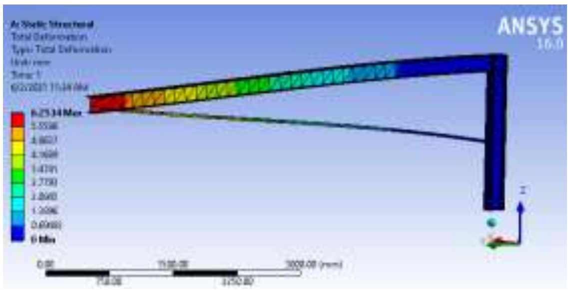
B. END OF THE SPAN



6.3.ANALYSIS OF REINFORCED JIB CRANE
6.3.1.STRUCTURAL STEEL
A. MIDDLE OF THE SPAN



B. END OF THE SPAN



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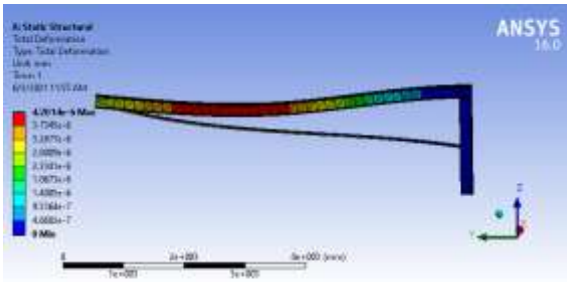
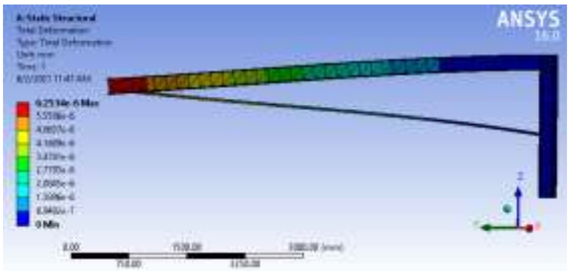
6.3.2.ASME A36 STEEL

A. MIDDLE OF THE SPAN



B. END OF THE SPAN



6.4.MESH DETAILS

- One of the goals of meshing is to make the problem solvable with Finite Element Analysis.
- Meshing divides the domain into parts, each representing a different element.
- You'll need these aspects to use Finite Element, because it's all about having a local basis for an Element and stitching together a collection of local solutions to create a global one.
- The Wall Mounted Jib Crane is meshed using tetrahedral elements with five nodes, as indicated in the diagram above. To capture the geometry in detail, first order elements are used.

6.5.METHODOLOGY

- Design Parameters of Mast and Boom is taken from Grobel.com.
- Design is done in UG-NX software.
- Analysis is done in ANSYS 16.0 Software.
- Analysis is done for two Materials i.e, Structural Steel and ASME A36 steel.
- Load of 6563 N is applied at Mid point and End Point for both materials.
- First Analysis is done on jib crane for both the materials and checked for Results.
- The deformation of jib crane is high compared to Manual Calculations.
- Then the design is reinforced.
- Now the analysis is done on reinforced design for both the materials.
- The analysis results are less than the calculated results, hence the design is safe.

VII.RESULTS

7.1.STRUCTURAL STEEL MIDDLE OF THE SPAN

	Without Reinforced	With Reinforced
Deformation	34.558 mm	4.201 mm

7.2.STRUCTURAL STEEL END OF THE SPAN

	Without Reinforced	With Reinforced
Deformation	106.59 mm	6.253 mm

7.3.ASME A36 STEEL MIDDLE OF THE SPAN

	Without Reinforced	With Reinforced
Deformation	3.45e-5 mm	4.20e-6 mm

7.4.ASME A36 STEEL END OF THE SPAN

	Without Reinforced	With Reinforced
Deformation	1.06e-4 mm	6.25e-6 mm

VIII.CONCLUSION

- The jib crane is designed and analysed in accordance with industry standards using the modelling programme UG-NX and the finite element solver Ansys.
- The job is done by modifying the model's design and using different materials.
- In the analysis section, the model was analysed at two loading conditions: mid-span and end-of-span, with the findings compared.
- The deformation values of the reinforced jib crane are lower than the actual jib crane, indicating that the deformation values are lower, implying that the jib's life time will be extended and the project's goal will be met.
- As part of the present project's expansion, the models are analysed while the materials are changed.
- After comparing the data, we found that the ASME A36 steel deformation values were lower than the structural steel. As a consequence, we believe that the reinforced jib with ASME A36 steel is a superior choice for industrial jib cranes because it will last longer and require less maintenance.

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